

Steep Slope Roofing

Division 070000-3 Thermal and Moisture Protection

General: Steep slope roofs are defined as roofs that generally include water shedding types of roof coverings installed on sloped planes greater than 3" in 12". All steep slope roofs shall be ventilated, at the minimum, as required by the Roofing System Manufacturer and the Kentucky Building Code.

3.1 Asphalt Shingles: Asphalt shingles come in different sizes and styles:

- Strip shingles are the most common type and measure 12"x36".
- Laminated strip shingle, sometimes called dimensional shingles, have additional shingle material laminated to the base shingle.
- Individual shingles are usually smaller than the strip shingles. These shingles are utilized to create patterns.

3.1.1 Materials and Components:

- Asphalt and fillers rely on the weather proofing material asphalt flux.
- Reinforcing is designed to carry and support the asphalt flux. The types of reinforcing are:
 - Organic Mats – cotton rag, wood fiber or other cellulose fibers.
 - Glass Fiber Mats – thin inorganic glass fibers.
- Surfacing is usually coarse mineral granules to protect asphalt coating, add weight and color choices.
- Self-Sealing Strip is an adhesive on the back of the shingle that increases wind resistance. They are covered by a release paper. The release paper is removed at the time of installation.
- Organic reinforced asphalt shingles shall conform to ASTM D-225. Glass fiber-reinforced shingles shall conform to ASTM D-3462.
- Warranty shall be a minimum 30 years.

Underlayment and Roof Slope: Asphalt Saturated Felt is the most common underlayment. There are a number of mats to choose from:

- Organic Mats made of cotton rag, wood fiber and/or other cellulose fiber.
- Glass fiber mats made of inorganic glass fibers.
- Polyester synthetic mats using synthetic fibers.

Polymer Modified Bitumen Sheets Underlayment use APP or SBS modification. Some of the materials offer better resistance to wrinkling and water shedding than traditional organic felts.

Ice Protection Membranes are used for additional protection from moisture along eaves and valleys where ice dams occur during winter. The most common type is a single layer of self-adhering polymer-modified bitumen membrane. The membrane thickness shall be a minimum of 40 mils thick and comply with ASTM D 170.

Asphalt Roof Cement is utilized as a bedding cement to seal around roof penetrations, walls, and metal flanges before installation of finished flashings. It is also used to seal down shingle tabs on more extreme slopes or in cold weather application.

3.1.2 Design considerations: Include a deck analysis for proper support and to provide adequate withdrawal resistance for fasteners. The slope for new construction shall not be less than 4" in 12". Asphalt shingles may be applied over wood plank, wood board and structural wood panels. The boards have to be butted together and not be warped, cupped or bowed. Roof deck design considerations:

- Wood plank or board is composed of solid-sawn dimensional lumber. It may be single or double tongue and groove or straight edged.
- Structural wood panels are plywood of various thickness as required by code.
- Steel roof decks can be utilized with a layer of plywood over the deck.

Underlayment and Roof Slope:

- On roof decks that have a slope of 4" in 12", then one layer of underlayment is the minimum requirement.
- On roof decks having a slope of 3" in 12" up to 4" in 12", then a minimum of two layers of 15# felt underlayment shall be applied in shingle fashion.
- From the gutter edge up the slope, an ice dam membrane shall be installed for a minimum of 36".

Flashings - Careful attention to flashing details is essential to successful long-term roof system performance. Flashing details include:

- Perimeter Edge Metal
- Penetrations
- Valleys
- Vertical Surfaces

Metal Types and Minimum Thickness:

- 26 gauge galvanized and prefinished steel
- 0.032 inch thick aluminum and prefinished aluminum
- 26 gauge stainless steel
- 16 ounce copper or lead-coated copper

Vertical Transitions: There are four types of metal flashings that are commonly used at vertical transitions:

- Apron Flashing – Metal used at a head wall i.e. down slope side of a chimney.
- Step Flashing – used at sidewall transition i.e. side of a dormer.
- Counter Flashing – secured to vertical wall and used to cover the top edge of an apron, step and/or cricket flashing.
- Cricket Flashing – used at the upslope side of a roof penetration i.e. at a chimney.

Metal Types and Thickness:

- 26 gauge galvanized and prefinished steel
- 0.032 inch thick aluminum and prefinished aluminum

- 26 gauge stainless steel
- 16 ounce copper or lead-coated copper

3.2 Tile Roofing: Tile Roofing has been used as a common steep slope roofing material for centuries.

Materials and Components:

- Clay tiles are extruded, cut to size, pressed into shape and kiln-fired at temperatures up to 2,000° F.
- Concrete tiles are extruded under high pressure and cured for a long period of time.

Roof tile shapes can be categorized as follows:

- Plain tile is flat slab or shingle tile.
- Pan and cover tile are installed with one tile laid concave and the adjacent laid convex (i.e., mission style).
- S-tile refers to the tile profile. It is a one piece pan and cover tile.

Standard specifications for Clay Tile Roofs are ASTM C1167. ASTM C1167 contains classifications for resistance to frost action. Currently there is no ASTM Standard for concrete roof tile.

Underlayment: Asphalt Saturated Felt is the most common. There are a number of mats from which to choose:

- Organic Mats made of cotton rags, wood fiber and/or other cellulose fibers.
- Glass fiber mats made of inorganic glass fibers.
- Polyester synthetic mats using synthetic fibers.

Polymer – Modified Bitumen Sheet Underlayment use APP of SBS modification. Some of these materials offer better resistance to wrinkling and water shedding than traditional organic felts.

Ice Dam Protection Membranes are used for additional protection from moisture along eaves and valleys where ice dams occur during winter. The most common type is a single layer of self-adhering polymer-modified bitumen membrane. The membrane thickness shall be a minimum of 40 mils thick and comply with ASTM D 1970.

Asphalt Roof Cement is utilized as a bedding cement to seal around roof penetrations, walls, and metal flanges before installation of finished flashings.

Design considerations include a deck analysis for proper support and to provide adequate withdrawal resistance for fasteners. A tile roof requires greater capacity to support heavier loads. Tile roofs may be applied over wood plank, wood board and structural wood panels. The end joints shall be centered over the supporting members. Boards shall not be warped, cupped or bowed. Some roof installations with tile include wooden batten systems. Roof Deck considerations include:

- Wood plank is composed of solid-sawn dimensional lumber. It may be single or double tongue and grooved or straight edged.
- It may vary in thickness from 2" to 4".
- Wood boards used for roof decks shall be a minimum of 6" nominal width.
- Batten systems are used to hang tile that has head lugs. Battens elevate the tile above a roof deck to facilitate venting and drying.

Underlayment and Roof Slope:

- The primary consideration of the underlayment is that it lasts the life of the primary roof. Many tile roofs outlive the underlayment felts.
- On roof decks that have a slope of 10" in 12" a minimum of one layer of 30# felt underlayment is recommended.
- On roof decks that have a slope of 4" in 12" a minimum of two layers of 30# felt underlayment is recommended as long as the tile is laid with a 3" head lap.
- From the gutter edge up the slope, an ice dam membrane shall be installed for a minimum of 36".

Tile Characteristics:

- Wind and seismic activity are design considerations for tile roofs. The field of the roof, rakes, ridges and eaves are subject to different wind uplift pressures and the possibility of seismic loading.
- Water absorption relates to the tiles ability to handle freeze/thaw cycles. Water absorption is expressed as a percentage of the weight of absorbed water in relation to the tiles' weight. Grade 1 provides resistance to severe frost action.
- Strength is the characteristic to withstand breakage. Typical flexural strength for clay tile is 650 pounds and approximately 400 pounds for concrete tile.

Flashing details include:

- Perimeter edge metal
- Penetrations
- Valleys
- Vertical surface

Vertical transitions: The four types of metal flashing that are commonly used at vertical transitions.

- Apron Flashing – Metal used at a head wall ie down slope side of a chimney.
- Step Flashing – used at sidewall transition ie side of a dormer.
- Counter Flashing – secured to vertical wall and used to cover the top edge of an apron, step and/or cricket flashing.
- Cricket Flashing – used at the upslope side of a roof penetration ie. at a chimney.

Metal Types and Thickness:

- 26 gauge galvanized and prefinished steel
- 0.032 inch thick aluminum and prefinished aluminum
- 26 gauge stainless steel
- 16 ounce copper or lead-coated copper

Warranty shall be a minimum of fifty years.

3.3 Slate Roofing: Slate roofing systems can be classified into three general categories:

- Standard Slate Roof Systems are composed of standard commercial slate 3/16 inch to ¼ inch thick. The most common slate has squaretails or butts There are a variety of patterns of slate.

- Graduated slate roof systems have various thickness, size and exposure. The thickest, widest, and longest are placed at the bottom and gradually diminishes as the slate progresses to the top for perspective and size effect. Thickness range from 3/16 inch up to 1 ½ inch.
- Textural slate roof systems have a range of thickness which are mixed throughout a roof system. These slates also have a rougher texture and uneven tails or butts.

3.3.1 Materials and Components: Slate comes from sediment beds that have been compressed under heat and load for centuries. Natural cleavage planes form that allows the slate to be split into relatively thin layers. This gives the surface texture. Color of slate is determined by its chemical and mineral composition. There are a wide variety of colors to choose. When selecting slate, use the word “unfading” or “weathering” to designate color stability. Weight of commercial standard thickness is about 850 pounds per square. Note that slate varies significantly in weight due to thickness and types from different quarries. Consult with supplier.

Standards: The ASTM C 406 “Standard Specification for Roofing Slate” addresses material characteristics physical properties and sampling procedures. ASTM C 406 has three grades of slate:

- Grade S have an expected service life of 75 to 300 years. It is recommended to use Grade S slate for all applications.
- Grade S² have an expected service life or 40 to 75 years.
- Grade S³ have an expected service life of 20 to 40 years.

Underlayment: Asphalt Saturated Felt is the most common underlayment. There are a number of mats to choose:

- Organic Mats are made of cotton rag, wood fiber and/or other cellulose fibers.
- Glass fiber mats are made of inorganic glass fibers.
- Polyester synthetic mats are made using synthetic fibers.

Polymer-modified Bitumen Sheet Underlayment use APP or SBS modification. Some of these materials offer better resistance to wrinkling and water shedding than traditional organic felts.

Ice Dam Protection Membranes are used for additional protection from moisture along eaves and valleys where ice dams occur during winter. The most common type is a single layer of self-adhering polymer-modified bitumen membrane. The membrane thickness shall be a minimum of 40 mils thick and comply with ASTM D 1970.

Asphalt Roof Cement is utilized as a bedding cement to seal around roof penetrations, walls, and metal flanges before installation of finished flashings.

3.3.2 Design considerations: Include a deck analysis for proper support and to provide adequate withdrawal resistance for fasteners. Because of the longevity of the roof system, deck material must also have a long service life, plus it must be able to support the heavier loads. Slate shall not be installed on slopes under 4” in 12”. Roof deck considerations are as follows:

- Wood plank is composed of solid sawn dimensional lumber. It may be single or double tongue and grooved or straight edged.
- It may vary in thickness from 2” to 4” thick.
- Wood boards used for roof decks shall be a minimum of 6” nominal width.

Underlayment and Roof Slope:

- The possibility of water migration through a slate roof shall be carefully considered. Slate roofs are designed for use as multi layered, water shedding roof system.
- On roof decks with a slope greater than 4" in 12" and less than 8" in 12", a double layer of modified bitumen underlayment shall be applied with an overlap of 19".
- On roof decks with a slope of 8" in 12" and above, a minimum of one layer of 30# felt or polymer-modified bitumen underlayment is recommended. NOTE: Two layers with a half lap is considered better.
- From the gutter edge up the slope, an ice dam membrane shall be installed for 36".

Fasteners:

- Shall be selected for long service life.
- Shall extend through the deck at least $\frac{3}{4}$ "

Copper slating nails shall be used. Standard sized slate shall be fastened with two nails. Slate that is subject to high winds shall be fastened with four nails. Slate $\frac{3}{4}$ " and thicker shall be fastened with four nails. The nail head shall not be driven tight. Rather, the nail head shall just touch the slate.

Flashings and details are essential to the long term performance of the roof system therefore the flashing materials must be of a thick enough gauge to achieve the expected design life of the slate roof system. Flashing details include:

- Perimeter Edge Metal
- Penetrations
- Valleys
- Vertical Surfaces

Metal Types and Minimum Thickness:

- 24 gauge prefinished galvanized steel
- 24 gauge stainless steel
- 16 ounce copper
- 16 ounce lead coated copper

Vertical Transitions: There are four types of metal flashings that are commonly used at vertical transitions:

- Apron Flashings – used at a headwall (i.e., down slope side of a chimney)
- Step Flashings – used at sidewall transition (i.e., side of a dormer).
- Cricket or Backer Flashing – used at the upslope side of a roof penetration (i.e., a chimney).
- Counterflashing – secured to a vertical wall and used to cover the top edge of an apron, step and/or cricket.

Metal Types and Thickness:

- 26 gauge galvanized and pre-finished steel
- 0.032 inch thick aluminum and pre-finished aluminum

- 26 gauge stainless steel
- 16 ounce copper or lead-coated copper

Warranty shall be a minimum of 75 years.

3.4 Metal: Metal roof systems come in a wide variety of choices:

- Shop fabricated with stationary equipment.
- Factory fabricated at manufacturers' plant.
- Field fabricated with portable equipment.

System Types:

- Architectural metal panel roof systems are water shedding roof systems. These systems shall be installed on slopes of 3" in 12" or greater. They require structural decking underneath with a minimum underlayment of a No. 30 asphalt-saturated felt and separate slip-sheet. An ice dam is recommended at gutters and valleys.
- Structural metal panel roof systems are water barrier type of roof systems that are structurally sound for spanning approximately 5 feet. These systems shall be installed with a minimum slope of 1" per foot. They do not require decking underneath because they get their strength from heavier gauge metal and stiffening ribs.
- Metal panels are available in a wide variety of configurations, ie. widths, cross section profiles and seam types.

Seam Types:

- Flat seam can adapt to many types of surfaces, i.e., steep slope, vertical walls or curved surfaces. Slips for securement are located in the seam.
- Flat seam can be non-soldered with overlapping flat pan panels in an interlocking shingle fashion. This system is not recommended for slopes under 8" in 12".
- Flat seam can be soldered. It has the same over lapping flat pan panels but because it is soldered, it can be utilized in low slope, weatherproof applications.
- Standing seam systems have laps with a raised vertical seam. Most standard seams have a male and female leg. Seam heights shall be a minimum of at least 1".

Seaming methods are determined by Roof System Manufacturers' requirements for our area. The seaming methods are as follows:

- Mechanical Seam done with hand seamers or machine seamers.
- Snap on Seams are simple to install with male and female legs adjoined to secure the seam in place. This seam is recommended for steep slopes only.
- An Intregal Seam is a tongue and groove assembly. This panel is used on steep slope applications.
- A Hooked Seam is a flat-lock seam used in a shingle fashion. It is a water shedding seam.

Panel lengths can be limited by shipping criteria. Length on panels can require the Roof System Manufacturer's input for expansion and contraction criteria.

Substrates for Architectural metal roof systems are steel roof decking and wood plank or plywood panel decks.

Spaced Structural Supports for structural metal panel roof systems are bar joists, light gauge framing and purlins.

Fasteners and attachment requirements shall comply with Factory Mutual and Underwriters laboratory requirements. Consult the Roof System Manufacturer's latest requirements. The fastening system recommended shall be presented through a shop drawing submittal process.

Thermal movement shall be a design consideration in fastening and attachment. The points of attachment can be at the hip and ridge, eave and valleys or in the middle of the roof panel. Consult with the Roof System Manufacturer.

Flashing details shall require consultation with the Roof System Manufacturer's detailing. The number of roof penetrations shall be kept to a minimum. Each detail shall be designed and reviewed for rakes, gutters, leaves, valleys, penetrations, ridges, hips, show guards, wall panels and curbs.

Materials stored on site shall be protected from water, humidity and direct sunlight. Panels shall be stored so that air can circulate through the stack and vent moisture away.

Warranty shall be a minimum of 20 years and cover the following:

- Premium weathertightness warranty shall cover both material and labor for the roof, valleys, ridges and projections (i.e. roof curb, equipment supports, plumbing stacks etc.) for a minimum of a lump sum amount that is two times the cost of materials.
- Surface finish.
- Color fastness.